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APLOMYA CAESAR (ALDRICH), A TACHINID PARASITE OF THE EUROPEAN CORN BORER*

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The European corn borer, *Pyrausta nubilalis* Hubn., has been remarkably free from attack by parasites native to North America. Only two, *Labrorychus prismaticus* Nort. and *Aplomya caesar* (Aldrich), have occurred regularly in Canada. Of these *Aplomya caesar* has been by far the more abundant on the borer. Its presence on corn borer was first noted by Vinal and Caffrey (12) in 1919, at which time it was identified as *Exorista nigripalpis* Townsend. Since it was first observed as a parasite of the borer in Canada, its rate of attack has been noted to vary from a fraction of one per cent to as high as twenty-six per cent at one eastern Ontario point in 1941. The degree of attack varies greatly from year to year and does not appear to bear any relationship to the rise or fall of the host population. Variations in the intensity of attack may be an expression of the scarcity or abundance of more preferred hosts. In general, however, the degree of parasitism has increased very markedly since it was first known to attack the borer. It is possible that this increase over a relatively long period indicates a gradual change in the habits of the parasite.

DISTRIBUTION AND HOSTS

Aplomya caesar has been recorded from the following states (Sellers, 8): New Hampshire, Massachusetts, Connecticut, New York, Michigan, Indiana, Illinois, Montana, Idaho, Washington, Colorado, Arizona, New Mexico, Ohio, California, District of Columbia and in the province of Alberta. The writer has taken it from corn borer in all areas in southern Ontario and southern Quebec where the borer is an important pest. It has been taken on corn borer also on Manitoulin Island.

The following hosts have been recorded: *Pyrausta nubilalis* Hubn., *Archips argyrospila* Wlk., *Archips semiferana* Wlk., *Archips rosaceana* Harris, *Archips practivittana* Clem., *Archips purpurana* Clem., *Archips fumiferana* Clem., *Phlyctaenia tertialis* Guén., *Pandemis limitana* Rob., *Amorbia humerosana* Clem., *Eulia quadrifasciana* Fern., *Archips parallela* Robinson, *Nygmia phaeorrhoea* Donovan, *Pyrausta penitalis* Grote, *Pyrausta ainsliei* Heinrich, *Loxostege commixtalis* Walk., *Loxostege sticticalis* Linn., *Papaipema nitela* Guénée.

DESCRIPTION

Adult: The adult fly (figure 1) was first described as *Exorista nigripalpis* by Townsend in 1896. In 1916 Aldrich (1) described it as a new species, *Exorista caesar*, from specimens submitted from Simcoe, Ontario. It was re-described by Aldrich and Webber (2) as *Zenillia caesar* in 1924. Sellers (8), 1943, places it under the genus *Aplomya* with the following synonymy and description:

"Exorista nigripalpis Townsend (nec Macquart 1846), *Psyche*, vol. 7, p. 330, 1896.—Coquillett, U. S. Dept. Agri., Div. Ent., Tech. Bull. 7, p. 93, 1897.—Tothill, Can. Ent. vol. 45, p. 71, 1913; Ottawa Nat., vol. 28, p. 114, 1914.—Gibson, Ann. Rep. Ontario Ent. Soc., 1918, p. 117.—Greene, Proc. U. S. Nat. Mus., vol. 60, art. 10, p. 11, fig. 83 (puparium), 1922.—Huber and Neiswander, Journ. Econ. Ent., vol. 17, p. 127, 1924.

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Exorista caesar Aldrich, Can. Ent., vol. 48, p. 20, 1916.—Caesar, Ann. Rep. Ontario Ent. Soc. 1916, p. 173.—Spencer and Crawford, Ontario Dept. Agr. Bull. 295, p. 7, 1923.

Zenillia caesar (Aldrich) Aldrich and Webber, Proc. U. S. Nat. Mus., vol. 63, art. 17, pp. 28-29, 1924.—Johnson, List of New England Diptera, p. 196, 1925; Biological survey of Mount Desert, the Insect fauna, pt. 1, p. 201, 1927.—Essig, Insects of Western North America, p. 581, 1926.—West, Cornell Univ. Agr. Exp. Stat. Mem. 101, p. 814, 1928.

"This species has been considered to be synonymous with *Aplomya mitis* Meigen, an introduced parasite of the European corn borer. This is another example of the resemblance of species between the Nearctic and Palearctic realms. The characters used to separate these two species are more or less relative in value, but, if carefully used, they will be found to be satisfactory.

"Frontal row of eight to ten bristles in male and six to eight in female, extending from on a level with base of third antennal segment to one reclinate prevertical; facial ridge bristly on lowest one-fourth in male, lowest one-sixth in female; gena one-sixth eye height; antenna black; palpus black.

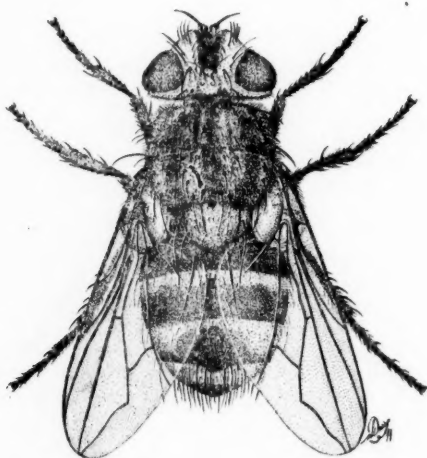


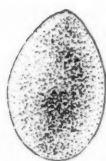
Fig. 1. *Aplomya caesar* (Aldrich)

"Thorax black, thinly gray-pollinose in male, more noticeably pollinose in female, with a bluish tinge; marked with five mesonotal vittae, the three median vittae very prominent before the suture and abbreviated behind; disk of scutellum covered with erect hairs, usual pair of discal scutellars lacking; hind tibia not ciliate; wing grayish hyaline, third vein with two bristles at base; squamae white.

"Abdomen black, gray-pollinose (more noticeably so in female) with a bluish tinge; second to fourth segments pollinose on basal two-thirds, varying from thinly gray pollinose to a heavier silver-gray pollinose laterally and basally; first segment, posterior one-third of segments two to four, and dorsal vitta shining black; abdominal hairs suberect in male, depressed in female; first and second segments with a pair and third with a row of marginal macrochaetae; fourth segment rather irregularly tipped with marginal and sub-marginal bristles that almost approach the macrochaetae in size, in the female the marginal bristles not at all developed. Length 5 to 7 mm."

Egg: The egg (figure 2) is microtype and is approximately .21 mm. long by .126 mm. wide. According to Townsend (11) it would be classed as of medium size. It is subovate, tapering slightly toward the cephalic end and is considerably flattened dorso-ventrally. Infertile eggs are uniformly pearly white in colour. Eggs containing fully developed larvae have a distinct greyish cast throughout. This appears to be imparted by the very dark colouration of the bucco-pharyngeal armature since the remainder of the contained larva is quite colourless. Moreover the chorion removed from an egg is pearly white. The upper part of the egg is chitinous while the under part is subchitinous. Inside

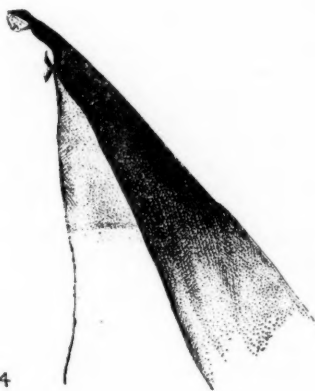
PLATE VII



2



3



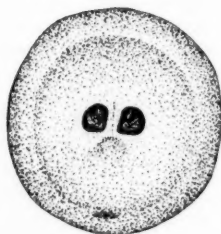
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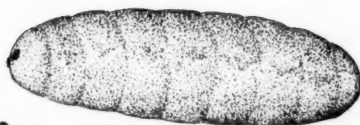
5



6



7



8

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the chorion, enclosing the fully developed embryo is a thin but strong vitelline membrane. The egg is fastened, thin side down, to the host food by a gelatinous material.

First-Instar Larva: Freshly hatched, the larva is .225 mm. long. During this instar it increases greatly in size, at the time of hibernation being 1.6 mm. long and when full grown approximately 3 mm. long. In shape, it is elongate, subcylindrical, tapering anteriorly and rounded posteriorly. The pseudocephalon is unarmed but bears small antennal and maxillary organs on either side of the mouth opening. Segments 1, 2 and 3 (thoracic) each bears a row of spines on the anterior margin which extends completely around the segment. Segments 4 to 10, each bears a row of spines on the anterior margin ventrally, extending to, but not beyond, the mid-pleural region. Segment 11 bears a few spines on the latero-ventral region but is bare on the mid-ventral area. The buccal armature is well developed, the chitinized portion being .07 mm. long at hatching (figure 3) and .26 mm. long at the time of hibernation (figure 4). Two posterior spiracles open on the dorso-pleural region of the last abdominal segment. The larva is metapneustic.

Second-Instar Larva: The newly moulted second-instar larva is approximately 3.75 mm. long and is more robust than the first instar larva. It is subcylindrical in shape, tapering anteriorly, and is truncate posteriorly. The pseudocephalon is unarmed. Segment 1 bears a small patch of spines on the anterior dorsal margin; segment 2 a small patch on the anterior margin both dorsally and ventrally, these extending laterally but not meeting; segment 3 bears a patch of spines on both anterior and posterior margins dorsally but none on either ventrally. Segment 4 bears a few spines on both the anterior and posterior margins dorsally. Segments 5 to 10 bear spines on the posterior dorsal margins, these increasing laterally and ventrally until on segment 10 they extend completely around the segment. No spines were observed on segment 11.

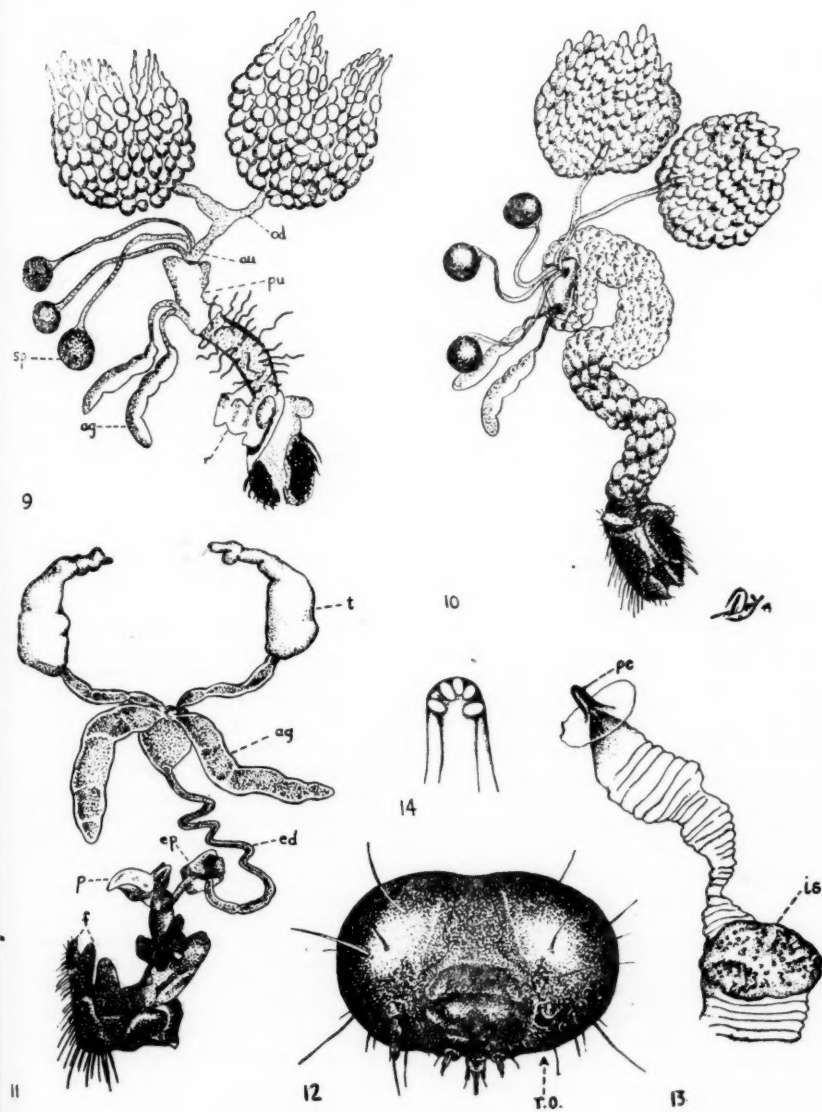
The bucco-pharyngeal armature (figure 5) is unarticulated and terminates in a pair of hooks.

The larva is amphipneustic. The anterior spiracles open on the first body segment and bear two very small papillae and are unpigmented. The posterior spiracles are well developed, each bearing two papillae. The spiracular chambers are scarcely twice as long as broad.

The sensory organs are similar to those of the first stage but are more prominent.

Third-Instar Larva: The third-instar larva is much larger than the preceding stage, measuring approximately 8.5 mm. in length shortly before leaving the host. As in the earlier stages the cuticle is colourless. In this stage the larva is more opaque, appearing to contain a large amount of fat. The spines on all the segments are very fine and difficult to locate. The pseudocephalon is armed with several rows of small spines around the mouth opening. Following is the arrangement of spines on the thoracic and abdominal segments: segment 1, fore margin, ten irregular rows dorsally, six rows pleurally and two or three ventrally; segment 2, fore margin, seven to eight irregular rows dorsally, three rows pleurally, and four rows ventrally; segment 3, fore margin, six irregular rows dorsally, sparse and irregular pleurally, three to four rows ventrally; segment 4, fore margin, six or seven irregular rows dorsally, five or six irregular rows ventrally, irregular on pleura, posterior margin, a few spines irregularly placed; segment 5, fore margin, four irregular rows dorsally and ventrally, posterior margin, two very weak rows; segment 6, fore margin, two to three rows weak spines ventrally and dorsally, posterior margin, few weak spines; segment 7, fore margin, few irregular spines, posterior margin, three or four irregular rows ventrally extending pleurally but not dorsally; segment 8, fore

PLATE VIII



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margin, two or three irregular rows of weak spines ventrally, posterior margin, four or five irregular rows ventrally extending beyond the pleura but not meeting dorsally; segment 9, fore margin, one or two irregular rows, posterior margin, five to six irregular rows dorsally and ventrally and meeting pleurally; segment 10, fore margin, two to three rows weak spines dorsally and ventrally but not meeting pleurally; segment 11, ten to eleven irregular rows of weak spines around stigmata, pointing forward. All spines on fore margin point backward and all on posterior margin forward.

The bucco-pharyngeal armature (figure 6) is articulated between the intermediate portion and the basal portion.

The larva is amphipneustic. The anterior spiracles are better developed than in the second instar and bear two papillae. The posterior spiracles are well developed and are raised above the surrounding part of the integument. They are heavily sclerotized, and each of the three respiratory slits is surrounded by a row of hook-like processes.

Puparium: The puparium (figures 7 and 8) is described by Green, 1921 (4), under the name *Exorista nigripalpis* Townsend as follows, "Small: subshining, yellowish red. Spiracles shining, black around the edge, reddish-yellow slits, each on top of a poorly defined ridge. Button, large, round, deep red. Spiracles located slightly above the longitudinal axis. Anal opening fairly large, far below the spiracles. Length, 5 mm. diameter, 2 mm."

This description agrees with the writer's observations except that puparia from corn borer are larger, measuring about 7.5 mm. in length and 2.75 mm. in width.

SEASONAL HISTORY

Aplomya caesar passes the winter as a first stage larva in the head of the host larva. Development proceeds rapidly in the spring, the first adults appearing during the last part of May. Records covering material held in a conservation cage at Belleville for the years 1933 and 1942 indicate that emergence may continue until the first of July, the peak occurring in the first ten days of June. Of a total of four hundred and sixty-nine adults observed, two hundred and ninety emerged between June 2 and 9. Adult females live upwards of forty days in the laboratory. It is possible, therefore, that the species can maintain itself on the corn borer since borer larvae are abundant in the fields by the middle of July. Some of the earliest emerging females may attack some of the other hosts mentioned. In Ontario and Quebec the parasite normally has one generation on corn borer. A few fresh puparia have been observed in growing corn in July in Essex County, Ontario, where the host has a partial second generation. In such cases the parasite also will have two generations.

REPRODUCTIVE ORGANS

Female: The reproductive organs of a freshly emerged virgin female are shown in figure 9. Each of the two ovaries is made up of a number of ovarioles, the number varying in the flies dissected from forty-eight to sixty-two in each ovary. Each ovariole contains eight or nine eggs, making a total of from about eight hundred to twelve hundred eggs for each female. The oviducts unite at the anterior uterus. The three spherical-shaped spermathecae are black in colour and are joined to the uterus by spermathecal ducts. Just posterior to the spermathecae are two accessory glands. The posterior uterus in freshly emerged females is short. At the time of emergence there are no eggs posterior to the ovaries, but if females are held without mating some eggs will descend into the anterior uterus and even into the posterior uterus. In one female held without mating for eighteen days, eighty eggs were found in the posterior uterus. After

mating, eggs descend into the posterior uterus, fertilization taking place as they pass the openings of the spermathecal ducts. As eggs enter the posterior uterus, it elongates greatly until it fills the greater part of the abdomen (figure 10). Seven or eight days from mating must elapse at seventy-five degrees Fahrenheit before oviposition occurs. Among the eggs first laid are many which are infertile.

Male: The male reproductive organs which are similar to those of other Tachinidae are shown in figure 11. The paired testes are joined to a common ejaculatory duct by the vasa deferentia. Joining the upper portion of the ejaculatory duct at near the same point are two relatively large accessory glands. A bulbous enlargement of the ejaculatory duct at this point probably functions as a seminal vesicle. Near the penis and appearing as an enlargement of the ejaculatory duct is the ejaculatory pump.

BIOLOGY

Mating: In laboratory propagation mating occurs quite readily in cages made of cotton and wood. Females are ready to mate shortly after emergence and will mate most readily when not more than two or three days old. Males are not as eager to mate during the first few days as they are when several days old. Copulation has been observed to last from one-half to two hours.

Oviposition: Oviposition has not been observed in nature. In the laboratory, females which have been held at seventy-five degrees Fahrenheit for eight days or longer will deposit their eggs along the freshly-cut surface of curl dock (*Rumex crispus*), corn or green beans. They are, however, stimulated to oviposit much more actively if these host food materials have been fed upon by corn borer larvae. It is probable that in nature they deposit by far the greater part of their eggs in areas where the hosts are feeding and thus where the eggs are most likely to gain admission to the host. The act of oviposition is accomplished by the female bending the abdomen forward between her hind legs until it touches the surface of the plant on which the egg is deposited. Oviposition continues over a period of three to four weeks or more, being most active during the first week.

Entrance of parasite into host: As is the case with other Tachinidae laying microtype eggs, the parasite gains entrance to the host body by being eaten along with the food on which the host feeds. There must of necessity be a great waste of eggs since large portions of the plant bearing parasite eggs remain uneaten. For laboratory observation, to ensure that the larvae under observation contained parasites, small pieces of green bean bearing numbers of eggs were placed in two-inch vials with host larvae which had been denied food for some hours. This resulted in practically all larvae thus treated bearing parasites but also resulted in considerable superparasitism.

Hatching of Eggs and Subsequent Movements of Larvae: A very simple method was used in observing what happens to the parasite egg after it is ingested by the host larva. Corn borer larvae fed on green beans lack to a large degree the opaque fat bodies characteristic of those fed on corn. For this reason they are somewhat transparent, and it is possible to observe something of what goes on inside the body by the use of a binocular microscope and transmitted light. A particularly clear view can be had if the larvae are immersed in water during the examination. A further advantage in the method is that the larvae do not have to be killed and can be kept under almost continuous observation.

As indicated earlier the chorion on the upper part of the egg is quite hard and that on the under part much less heavily chitinized. It was observed that very few eggs passed into the foregut without being freed from the chorion. It can be safely assumed that the escape from the chorion occurs as the eggs pass the mandibles, as it was determined that very little pressure with a dissecting needle would result in the separation of the chorion from the rest of the egg. Hatching

of the embryo from the vitelline membrane takes place very shortly afterwards. In the cases observed, hatching took place in the foregut or the fore portion of the midgut less than an hour after the ingestion of the egg.

The pressure of the mandibles appears definitely to remove the chorion from the egg but does not cause actual hatching. Severin, Severin and Hartung, 1915 (9), in some work on the hatching of tachinid eggs, found that the eggs of *Chaetogaedia monticola* hatch quite readily when in an alkaline medium such as .1 per cent sodium hydroxide. The writer immersed eggs in distilled water and .1 per cent sodium hydroxide solution and did not observe any hatching, but eggs dissected out of a gravid female hatched in human saliva which showed a slightly alkaline reaction. Whether the hatching is produced by an increase in turgidity in the egg brought about by the immersion of the egg in the juices of the digestive tract, or whether the larva enclosed in the vitelline membrane is stimulated to work its way out of the enclosing membrane, was not determined. It was observed, however, that there is considerable activity of the mouth hooks at the time of hatching.

When the larva is free from the chorion of the egg, it immediately proceeds to work its way through the walls of the digestive tract. This is accomplished by the use of the mouth hooks and takes a very short time, probably not more than fifteen minutes. Larvae were observed in the body cavity less than one hour after the parasite eggs were eaten by the host. Passage from the digestive tract to the body cavity was observed only in the region of the foregut or the anterior part of the midgut. It may occur posterior to this, but if so it was not observed, and in the many dissections which were made parasite larvae were not found in the body cavity posterior to the thoracic region.

As soon as the larva is free in the body cavity it begins to move cephalad and continues to do so until it comes to rest between the adductor muscles of the mandibles, usually with the mouth hooks near and pointing toward the vertex. Occasionally one is found near a gena or near the frontal suture. Of fifty-seven examined, fifty-three were in the normal position. Of the fifty-seven, twenty-seven were in the right side of the head and thirty in the left. Parasite larvae reach this position usually within a couple of hours after leaving the digestive tract and none were observed elsewhere after twenty-four hours.

In nature where the host has a single generation in a year, the parasite hibernates in this position. In the laboratory, if the parasitized hosts are kept at constant high temperatures (eighty degrees Fahrenheit), a proportion of them will come through without a diapause. This portion corresponds roughly to the percentage of hosts which pupate if unparasitized. This leads to the conclusion that the diapause tendency of the host is responsible for the same tendency in the parasite and that parasite development from this stage on will continue only if the diapause requirements of the host have been met or if the parasitized host has been prevented from developing such a tendency by being reared at constant high temperatures.

From this point on, most of the observations were made on hibernating hosts and parasites which had been collected in the field. Parasitized hosts were selected from large numbers of field collected larvae by examination under water as indicated previously. These were kept in cold storage to prevent development until they were wanted for study, when they were brought out for incubation. During development the hosts were examined daily or more often, and the position of the parasite larva as indicated by the position of the buccal armature was recorded on an outline drawing of a host head, previously prepared. By this method it was possible to observe the movements of the larva within the host until the respiratory funnel was formed, and in some cases longer. Sufficient dissections were made to verify the findings thus made. A total of thirty-three

parasite larvae was observed during development from the time of the starting of incubation until the parasite larvae left the host and the puparia were formed. The length of time required for this development at seventy-five degrees Fahrenheit varied from eight to twenty-three days. Previously it had been noted, during the rearing of large numbers of corn borer larvae for recovery studies, that the time required was from six to eight days. In these larvae the rearing was done in the spring and summer after winter storage and when the diapause requirements of the host had been completely satisfied. The observations now being discussed were made in December and January, when the diapause requirements of the host and hence of the parasite were only partially satisfied. It was noted that, from the time the parasites in this material first started to show signs of development, the period required was from six to eight days as in the case of that occurring in larvae kept for a normal diapause period.

The first-instar larva during hibernation remains in the position described above. After about two days of incubation (seventy-five degrees Fahrenheit), it moves forward toward the region of the antenna in the same side of the head in which it spent the winter. When it reaches the antennal sclerite, using the mouth hooks in a back and forth motion, it cuts out the antenna, leaving a neat hole more or less circular in shape (figure 12). The observed time required for the cutting of this hole was slightly more than two hours. As soon as the hole is cut and there is access to the air, the larva turns about and places its caudal end against the aperture, at times projecting it somewhat beyond the contour of the head. This reversal of position takes place very rapidly, occupying not more than fifteen minutes from the time the hole is cut.

Approximately ninety per cent of the respiratory openings are formed in the position indicated above, that is at the antenna of the same side of the head in which the larva spent the hibernation period. Two, in about fifty cases observed, crossed to the other side of the head before going to the antenna; one formed its opening under the labrum, one in the submentum, and one in the hypopharynx.

The manner of making this respiratory opening in the Tachinidae is a matter of some difference of opinion. In *Compsilura*, where the respiratory opening is in a trachea, Tothill, 1922 (10), states, "It seems probable that a maggot enters head first and then passes partly out again, coming to rest with the posterior spiracles in the lumen of the trachea." Pantel, 1898 (7), on the other hand, states that the making of the respiratory opening is the reverse of what occurred in the making of the primary opening by which the parasite (*Thrixion*) entered the host and is accomplished without any intervention of the buccal armature, but by means of the postabdominal spiracles. Clausen, 1940 (3), states that various later authors have corroborated this conclusion.

The evidence in the case of *Aplomya caesar* is absolutely conclusive. Apart from the fact that the cutting of the hole has actually been observed, at no time until after the hole is made does the caudal end of the parasite approach the position where the hole is made. Moreover examination of first-instar larvae at this time reveals no trace of chitinization in this region which would be useful in making an opening in this manner.

There has been, perhaps, a tendency to accept Pantel's (7) description of what occurs in *Thrixion* as typical of what occurs in the Tachinidae in general. Keilin, 1944 (5), in his paper on the respiratory systems of Diptera, uses Pantel's work as an example in his section on "Larvae with spiracles attached to respiratory apertures and surrounded by chitinous envelopes". Pantel's work is undoubtedly accurate, but *Thrixion* might be considered to be an exception as to behaviour rather than typical. In the first place, it attacks an orthopterous insect which, to say the least, is one of the lesser orders in so far as attack by the

Tachinidae is concerned. It further emphasizes its deviation from the usual by leaving the host through the entrance hole. This is certainly not typical, nor has the writer observed any other example in the literature. It is probable that further investigation will reveal that many parasites in this group make the respiratory opening by the use of the buccal armature, particularly in the case of first-instar larvae from microtype eggs. Tachinid larvae from macrotype eggs make an opening with the buccal armature to enter the host. This is a primary opening. The opening made for respiratory purposes later is a secondary opening and is usually made by a second-instar larva. The opening made by *Aplomya* is a primary opening and is made by a first-instar larva. It might be assumed, until contradictory evidence appears, that first-instar larvae, whether from macrotype or microtype eggs, make holes in the body integument either from without or from within with the mouth hooks, while second-instar larvae may use the post-abdominal spiracles to make respiratory openings.

Once respiration is established through the opening, development proceeds rapidly. By the end of twelve hours the larva has reached between two and three times its former length. The first moult occurs between twenty-four and forty-eight hours after the respiratory opening is made. In moulting, the skin is ruptured dorsally near the posterior end, and the cast comes off over the anterior end, being found at this time at the edge of the respiratory funnel. The respiratory funnel starts to form as soon as the opening is completed and reaches considerable size in twenty-four hours. Pigmentation appears about the time the first moult occurs. The funnel continues to grow until the time the parasite leaves the host, extending backwards into the second thoracic segment and occupying practically the whole of one side of the head and broadening out to fill almost completely the first thoracic segment. About thirty-six hours after the first moult, the parasite casts its second skin. On dissection of the host, after the parasite has left, both the first and second exuviae may be found in the respiratory funnel. After the second moult, the larva feeds very actively, devouring a good deal of the organs in the thorax and abdomen. At this time it is quite active, and its connection with the funnel does not appear as intimate as previously. It can be noted feeding well down into the abdominal region. However, when the time comes for it to leave the host, it retreats into the funnel, bringing its oral region to the first or second abdominal segment. Here, by means of the mouth hooks, an exit is made. The point of exit is quite uniform, being at or near the ventral side of the segments mentioned. The parasite larva leaves the host head first and forms the puparium about an hour later.

This method of leaving the host is different from that described by Nielsen (6) for *Bessa selecta* Meig. He describes it as follows: "This act is commenced by the parasite pressing the posterior tip against the inside of the skin (host) so as to produce a bulging out on that spot: simultaneously it voids its excrement as a fluid and thus makes that part of the skin moist. Gradually the chitin on the skin disappears on the parts at the tail-end of the parasite, and an opening is made through which the fly larva crawls out, posterior end first". The present author has observed a similar method of leaving the host in *Paratheresia claripalpis* V. D. W.

Emergence of the adult from the puparium takes place eight days later and is accomplished in the usual way, by the expansion of the ptilinum.

SUMMARY

Aplomya caesar (Aldrich) is a native parasite attacking the corn borer, *Pyrausta nubilalis* Hubn. It lays its eggs on cut or fed-upon surfaces of the host food. It is the most abundant native parasite of the corn borer.

The various stages of the parasite are described.

The parasite has as many generations per year as the borer, which means that for the most part in Ontario and Quebec it is single brooded. It winters as a first-stage larva in the head of the host.

In the laboratory the adults mate well and oviposit freely in cages. Females produce about one thousand eggs. The egg is eaten by the host, hatches in the digestive tract, and the larva bores through the digestive tract into the body cavity, taking up a position in the head. After hibernation the larva moves forward, and with its buccal armature cuts a respiratory opening at an antennal sclerite. A respiratory funnel is formed at this point. After hibernation is completed, six to eight days are required until the puparium is formed and a further eight days to the emergence of the adult fly.

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EXPLANATION OF PLATES VII AND VIII

- Figure 2. *Aplomya caesar*. Egg, X 110.
3. *Aplomya caesar*. Bucco-pharyngeal armature, 1st stage larva at hatching, X 700.
4. *Aplomya caesar*. Bucco-pharyngeal armature, 1st stage, after hibernation, X 250.
5. *Aplomya caesar*. Bucco-pharyngeal armature, 2nd stage, X 185.
6. *Aplomya caesar*. Bucco-pharyngeal armature, 3rd stage, X 115.
7. *Aplomya caesar*. Puparium, posterior view, X 125.
8. *Aplomya caesar*. Puparium, lateral view, X 72.
- Figure 9. *Aplomya caesar*. Reproductive system, newly emerged virgin female, X 25 approx.; od., oviduct; au., anterior uterus; pu., posterior uterus; sp., spermatheca; ag., accessory gland.
10. *Aplomya caesar*. Reproductive system, gravid female, X 25 approx.
11. *Aplomya caesar*. Reproductive system, male, X 25 approx.; ag., accessory gland; ed., ejaculatory duct; ep., ejaculatory pump; f., forceps; p., penis; t., testis.
12. Head of host larva (*Pyrausta nubilalis* Hubn.), X 20; r.o., respiratory opening made by *Aplomya caesar*.
13. *Aplomya caesar*. Pupal respiratory apparatus, 3rd stage larva, X 115; pc., prothoracic cornicle; is., internal spiracle.
14. *Aplomya caesar*. Tip of prothoracic cornicle, X 490.

NEW NORTH AMERICAN EUPITHECIAS I (LEPIDOPTERA,
GEOMETRIDAE)*BY J. McDUNNOUGH,
Ottawa, Ont.

In the course of my work on North American Eupithecias a number of species have gradually accumulated which I had, from time, to time, tentatively set aside as probably new but which I did not venture to describe as such until I had secured a better working knowledge of the species already named. Rightly or wrongly I believe I have now attained this desirable position and in consequence offer herewith descriptions of certain new species together with genitalic figures of both sexes, as far as material is available. A fine lot of material, collected recently by Mr. V. Nabokov of Cambridge, Mass., in Utah, has been most helpful in augmenting my series in many cases, and I am very grateful for the opportunity of studying this collection.

Eupithecia conglomerata n. sp.

Female. Antennae simple. Palpi moderately long, projecting considerably beyond front, blackish brown. Front flat, a somewhat lighter smoky brown color than palpi and showing faint paler marbling. Head and thorax similar in color to front. Abdomen with a narrow, blackish transverse posterior band on second segment and two lateral black longitudinal bands: between these bands the dorsum is quite characteristically suffused with a rather bright brown color; at times (in fresh specimens) there is an indication of a pale medio-dorsal line and the posterior margins of the segments are partially tipped with white scaling. Primaries a rather even smoky brown, tending (in fresh specimens) toward gray-brown, and with an even sprinkling of white scaling. The usual dark cross lines are improminent and the most striking feature is a *dentate white subterminal line* which bends outward slightly below costa and then runs parallel and close to the outer margin, terminating just above tornus in a somewhat enlarged white spot, weakly relieved by black scaling. The basal, ante median, median and postmedian lines are indicated on costa by small dark blotches; their course is outlined by faint dark dots on the veins and in general is somewhat inwardly oblique with a weak outward bend at costa. The median line runs through a *prominent black upright discal streak*, a second characteristic feature of the maculation. There is a slightly broken black terminal line. Secondaries pale smoky with deeper shading along outer and inner margins and faint traces of the white subterminal line of primaries; there are also indications of smoky, curved, ante- and postmedian cross-lines and of a minute discal dot. Fringes on both wings feebly checkered.

Beneath the primaries are deep smoky with the median and postmedian costal blotches and the discal streak well-marked. The white s. t. line is broader and less dentate than on upper side. On the pale smoky secondaries the discal dot and the two curved cross-lines are better developed and the white s. t. line is more band-like in character, relieved on both sides by darker shading. Expanse 20 mm.

Genitalia (Fig. 1). Ostium membranous. Collar and neck broad and well-chitinized, the chitinization extending down into the upper half of the bursa and showing numerous striations. At the edge of this area on the left side (right in figure) is a cluster of long spines and on the right side a larger patch of spines extends upwards from the edge of the chitin to the ductus seminalis which arises at the base of the neck as a small membranous mound. On the ventral side there are a few long spines clustered around the inception of the ductus and weak spiculation continues the lateral patch of spines for a short distance towards centre. The fundus of the bursa is membranous with a few scattered spines occurring in its central area.

*Contribution No. 2338, Division of Entomology, Science Service, Department of Agriculture, Ottawa.

Holotype—♀, near Ashfork, Ariz., July 20, 1930; No. 5596 in the Canadian National Collection, Ottawa.

Paratypes—1 ♀, Graham Mts., Ariz., Aug. 12, 1933 (O. Bryant); 1 ♀, Todd's Lodge, Oak Cr. Can. Ariz., Sept. 14, 1941 (G. & J. Sperry); 1 ♀, McNary, Ariz., Aug. 10-15 (S. E. Cassino Coll.); 1 ♀, White Mts., Ariz., Aug. 15-30 (S. E. Cassino Coll.); 1 ♀, Eureka, Utah, Aug. 14, 1911 (T. Spalding); 2 ♀, Alta, Utah, June 29, Aug. 5, 1943 (V. Nabokov); 2 ♀, Almont, Colo., July 1-15 (S. E. Cassino Coll.). The specimen from Todd's Lodge will be deposited in the Sperry Collection and 4 ♀ from McNary and White Mts., Ariz.; Alta, Utah; and Almont, Colo., will be returned to the Museum of Comparative Zoology, Cambridge, Mass.

***Eupithecia nabokovi* n. sp.**

Rather similar to the preceding species but smaller in size, with much shorter palpi and with more evenly dark secondaries.

Male antennae finely ciliate, female simple. Palpi short, scarcely exceeding the flat front, deep smoky. Head and thorax smoky brown; abdomen similar in color with traces of a whitish dorsal line and some faint black lateral spots on the central segments but without the strong lateral black lines and the median light brown shading of the previous species. Primaries of an even smoky brown color, finely sprinkled with whitish, with obsolescent cross-lines, except for a white, dentate, s. t. line, and with a prominent, black, slightly outwardly oblique, discal streak; the type of maculation is very reminiscent of the preceding species but the white spot above tornus is a little more prominent and there is *no dark terminal line*; at costa beyond the inward bend of the t. p. line there is a faint paler patch and the median area in the section between costa and discal streak is slightly darker in color than the remainder of the wing, giving the appearance of an incipient dark band. The fringes are smoky, faintly checkered, and with a pale line at base. Secondaries rather deep smoky, scarcely paler than primaries; there is a faint dark discal dot and traces of a dark median band almost touching this dot and only visible in lower half of wing; there is a rather *distinct white dot* at inner angle, being the termination of the otherwise obscure, dentate s. t. line.

Beneath primaries deep smoky with the pale costal spot and white s. t. line fairly well-defined. Secondaries considerably paler than above with the upper side markings reproduced rather more distinctly; there is also an obscure, dark, subterminal, shade-line, defining the s. t. line on its inner side. Expanse 17 mm.

Genitalia. Male. (Fig. 2a). Plate of eighth segment consisting of two thin, slightly incurved, chitinous rods, narrowly joined at base. Uncus bifid. Clasper normal, broad at base, tapering apically. Aedeagus armed with three pointed rods of chitin., one of which is curved apically and the longer of the other two bent at the base. There is also an obscure, irregular piece of chitin and a weakly chitinated ribbon, rounded apically, finely veined, and projecting between the ends of two of the rods.

Female. (Fig. 2). Difficult to elucidate, due to small size and poor inflation. The most characteristic feature is a short broad chitinous collar, projected downward into a sort of *shoulder*, *putting out on the left side* and beneath which is a *series of long spines*. The globular bursa is largely filled with a conglomerate mass of spining, which spreads out into longer spines toward fundus; the right side is more membranous with only weak spining. The membranous fundus in my material appears as a pointed appendage but this may merely be due to poor inflation and will need checking. The ductus seminalis arises more or less ventrally on the right side as a small membranous bulb which almost immediately narrows to a very fine tube.

Holotype—♂, Alta., Utah, Aug. 1, 1943 (V. Nabokov) in Museum of Comparative Zoology, Cambridge, Mass.

Allotype—♀, same data, July 29.

Paratypes—2 ♂, 3 ♀, same data, July 22, 23, 28, Aug. 1; 1 ♀, Jemez Spgs. N. Mex., Aug. 16, 1919. This latter and 1 ♂, 2 ♀ of the Alta specimens being No. 5597 in the Canadian National Collection, Ottawa.

I take great pleasure in dedicating the species to my friend, V. Nabokov, from whom I have received much interesting material in this genus for study.

***Eupithecia appendiculata* n. sp.**

Antennae gray, annulate with blackish, very finely ciliate in male, simple in female. Palpi quite short, scarcely exceeding the flat front, blackish, with a white tip on third joint. Head and front deep gray with traces of black scaling across the front just anterior to the antennae and with the anterior margin suffused with blackish. Thorax deep gray. Primaries rather evenly deep gray with quite obsolescent maculation, the usual cross-lines being scarcely traceable in the basal half of the wing. There is a small, dark, slightly elongate, discal dot and an indication of a postmedian line, bending outward below costa and then more or less parallel to outer margin: it is relieved outwardly by a slightly paler band, angled below costa. The terminal area of wing is somewhat darker, being shaded with smoky, especially at costa, where it forms an obscure rectangular blotch; through this darker area a fine, whitish, s. t. line may be traced, feebly dentate below costa and terminating above tornus in a very slightly enlarged spot. A terminal blackish line, broken by white dots at ends of veins. Fringes concolorous and rather well checkered with smoky in basal half. Secondaries evenly deep gray with little trace of maculation; a small, dark, discal dot; terminal area and fringes as on primaries.

Beneath somewhat paler than above, the upper side maculation of primaries repeated. On secondaries a dark, bent, postmedian line is present, well beyond the small discal dot; there are also indications of a dark s. t. line. Fringes on both wings well checkered. Expanse 17-18 mm.

Genitalia. Male. (Fig. 3a). Uncus bifid. Claspers normal, tapering gradually to a rounded apex. Aedeagus rather broad, armed with a large piece of hollowed-out chitin, split at the base. Apically there are two short chitinous rods and proximad of these is a stronger rod, the basal half of which is well-spiculate. There is the usual small, twisted, basal piece of chitin. Ventral plate of the eighth segment composed of two thin rods, slightly incurved at apices and narrowly joined at base.

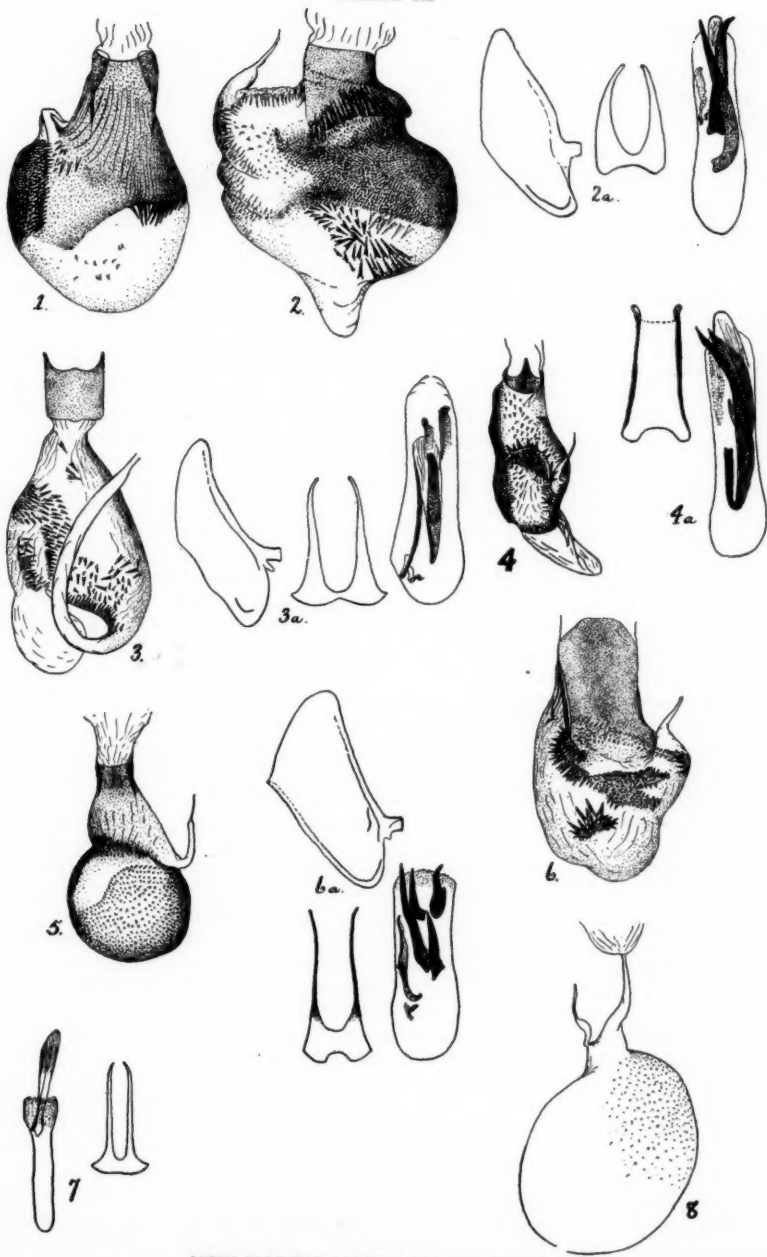
Female. (Fig. 3). Very characteristic and probably most closely associated with *subcolorata* Hlst. and *scriptaria* H.S. Ostium armed with a large rectangular plate of chitin, with caudal margin well-excavated. A short membranous ductus leads into the lengthily oval and membranous bursa-sac; the ductus seminalis originates at the base of the bursa on the right side as a good-sized tube which curves caudad across the ventral surface of the bursa, opposite this on the left side is a small, oval, entirely membranous, secondary sac. The entrance to the ductus seminalis is armed with long spines and irregular patches of similar spines extend obliquely backward, across both sides of the bursa. The proximal portion of the bursa shows considerable striation, especially on the right side.

Holotype—♂, Alta, Utah, July 28, 1943 (V. Nabokov) in Museum of Comparative Zoology, Cambridge, Mass.

Allotype—♀, same data, Aug. 8; No. 5598 in the Canadian National Collection, Ottawa.

Paratypes—1 ♂, 2 ♀, Santa Ana River, S. Bernardino Mts., Calif., 5500 ft., July 26, Aug. 2, 1907 (J. Grinnell); 1 ♂, same data, S. Fork, 6200 ft., July 11; 1 ♂, Atascadero, Calif., July 26, 1935 (E. C. Johnston).

PLATE IX



NEW NORTH AMERICAN EUPITHECIAS

- Female Genitalia of 1. *Eupithecia conglomerata* n. sp. 2. *E. nabokovi* n. sp. 3. *E. appendiculata* n. sp. 4. *E. carneata* n. sp. 5. *E. litoris* n. sp. 6. *E. neomexicana* n. sp. 8. *E. dichroma* n. sp.
 Male Genitalia of 2a. *Eupithecia nabokovi* n. sp. 3a. *E. appendiculata* n. sp. 4a. *E. carneata* n. sp. 6a. *E. neomexicana* n. sp. 7. *E. johnstoni* n. sp.

My California specimens are in poor condition and for this reason I have designated the much fresher Utah specimens as holotype and allotype. The genitalia of both series agree except that in the California females the bursa shows a quite prominent shoulder above the spined area on the left side; this is probably due to the poorly inflated condition of the bursae.

***Eupithecia carneata* n. sp.**

Antennae in male rather thick and somewhat laterally compressed, very finely ciliate; in female simple, annulate with black. Palpi short, barely exceeding front, black, with slight whitish scaling at base. Head and front largely black-scaled, the front flat and with some light ochreous scaling in central area, beyond which the anterior margin is strongly black. Thorax light ochreous or flesh-color, shaded, especially anteriorly, with blackish scales. Primaries narrow, in color a light carneau, shaded with blackish along costa and terminally. The black color of costa gradually broadens from base to apex and is cut by several obscure geminate streaks in the basal half and by a much better defined bar of the ground color beyond the postmedian line. The antemedian area is crossed by several dark, slightly wavy and inwardly oblique, fine lines; the median area contains an inwardly oblique blackish band, broad and prominent on costa, where it forms a dark triangular patch enclosing the discal streak, but paling and narrowing considerably in lower half of wing where it becomes suffused with ground-color; the subterminal area is broadly carneau, narrowed at costa, and containing three obscure, wavy, dark, hair-lines; the terminal area is deep smoky, especially on its inner side at costa and at a spot above tornus, and contains a faint whitish, dentate, s. t. line which broadens to a spot in interspace above vein Cu₁. A dark terminal line, slightly broken at the veins and followed by a pale line at base of fringes, which are largely smoky and faintly checkered. Discal streak quite prominent and composed of raised, dark scaling. Secondaries rather heavily suffused with deep smoky, especially in basal and terminal areas, leaving paler areas along costa and across central portion of wing; a faint tinge of carneau along inner margin. There is a small dark discal dot and also indications of several parallel dark cross-lines, especially in basal half above inner margin. A whitish irregular s. t. line runs through the dark terminal area, expanding to a larger spot which touches outer margin in the cubital interspaces and to a smaller spot just before anal angle. Terminal line and fringes as on primaries.

Beneath pale smoky, somewhat shiny. Apex of primaries with dark patch, preceded on costa by a pale bar; secondaries with indications of curved median and subterminal lines. Discal dots on all wings. Expanse 17 mm.

Genitalia. Male. (Fig. 4a). Ventral plate of eighth segment weakly and narrowly chitinized along its lateral edges, forming two bars, the apices of which project slightly, and are somewhat expanded and bluntly rounded.

Uncus simple. Clasper normal, rather narrow. Aedeagus armed with two strong, curved chitinous bars, bent backward at base and with sharply pointed apices; there is also a broad, apical, weakly chitinized plate, rounded distally and faintly striate.

Female. (Fig. 4). Very characteristic. Ostium membranous. Collar broad and well-chitinized, the edges strongly curved upward; from the central area a *characteristic chitinized point* projects caudad. Bursa narrow and elongate with an additional *membranous appendage* extending beyond the spined section. The central portion of the bursa is almost subdivided by a *semicircular upright chitinous plate*, the ventral edge of which is furnished with a series of long, stout spines. From the lower right side of the bursa the thin ductus seminalis extends caudad. With the exception of the proximal area and an area distal of the chitinous plate the bursa-surface is spined, especially in the lateral and dorsal areas.

Holotype—♀, Oak Creek Canyon, nr. Flagstaff, Ariz., Aug. 29, 1941 (W. P. Medlar); No. 5599 in the Canadian National Collection, Ottawa.

Allotype—♂, Alta, Utah, Aug. 15, 1943 (V. Nabokov) in Museum of Comparative Zoology, Cambridge, Mass.

Paratype—1 ♀, same data as Allotype, Aug. 18.

The Utah specimens are very worn and in consequence I have made the much better preserved Arizona specimen the Holotype.

***Eupithecia dichroma* n. sp.**

Female. Antennae rather thicker than usual, very finely ciliate. Palpi quite long, projecting well beyond front, blackish with pale tip of third joint and whitish shading at base and ventrally. Head and front with closely appressed scaling of a mixed black and whitish coloration; front slightly rounded with the anterior margin and a transverse line just in front of the antennae, black; there is also a partial black band on the vertex behind the antennae. Thorax similar in color to head with tinges of pale carneau on the patagia. Primaries with the ground-color a pale carneau-brown, most pronounced in the basal and subterminal areas. A broad blackish band crosses the median area, the outer margin of which is formed by the t. p. line which is gently rounded outwardly below costa and then parallel to outer margin (unfortunately the inner section of the wing in my type specimen is rubbed and I am unable to determine whether the black band is continuous across the entire wing but there are indications that it is). A prominent black discal streak is contained in this dark band. Costa between band and base shaded with black. The t. p. line is bordered outwardly by a narrow pale band which shows vestiges of a central dark hair-line; following this the s. t. space is broadly carneau-brown and the terminal area is strongly shaded with blackish with some carneau tinges and through which traces of a white s. t. line—as scattered spots—are visible; some white sprinkling is evident along outer margin and there is a weak, dark, border line, broken, as usual, by pale dots on the veins. Fringes pale smoky with pale basal line and feeble dark checkering. Secondaries dull whitish; the extreme base of wing is heavily shaded with smoky; the median area up to a dark rounded postmedian line paler, with only slight sprinkling of smoky, it includes a small dark discal streak; the subterminal area is moderately smoky and bordered outwardly by a slightly dentate smoky line, parallel to outer margin and edged outwardly with whitish; terminal area heavily smoky, forming more or less of a dark marginal band. Fringes as on primaries.

Beneath pale smoky white with the maculation of the upper side faintly reproduced in smoky. Expanse 17 mm.

Genitalia. (Fig. 8). Ostium membranous. Ductus bursae a long fine tube expanding to a short neck, three times as broad as ductus, from left side of which the ductus seminalis arises. Bursa large, globular, entirely membranous, with faint indications of very fine spiculations over most of its surface.

Holotype—♀, Alta, Utah, June 30, 1943 (V. Nabokov) in Museum of Comparative Zoology, Cambridge, Mass.

Judging by Petersen's figures (1909, Iris, XXII Pl. III) *dichroma* evidently belongs, along with the following species, in the same group as the European *linariata* and *pyreneata*.

***Eupithecia johnstoni* n. sp.**

Male. Antennae thin, very finely ciliate. Palpi quite long and projecting well beyond front, blackish, with pale tip to third joint and whitish scaling centrally at base. Head and front with closely appressed scaling, largely blackish with pale sprinkling in central area of front and behind the antennae. Thorax largely pale with black shading on the anterior portion and across the patagia. Primaries broad and with clear, well-defined maculation. Ground-color a dull whitish, crossed by light ruddy-brown subbasal and subterminal bands and

with a large, blackish, median, costal area, enclosing the prominent discal streak. Basal area considerably sprinkled with blackish and bordered outwardly by an inwardly oblique black basal line, sharply angled at costa. Beyond this line is a narrow parallel band of ground color followed by a broader and characteristic band of ruddy-brown, broadest in central area of wing and edged outwardly by a black line, sharply angled outwardly below costa and with an inward angle in the fold. Again a pale parallel band follows, bordered outwardly by the black antemedian line which forms a very sharp outward angle in cell and then proceeds irregularly and inwardly oblique. The median area between antemedian and postmedian lines contains a large, blackish patch extending across the cell in its inner section but more diffused with white scaling and less sharp in outline toward the t. p. line; it contains the large black discal streak. The lower half of the median area is of the light ground color, crossed by several dark lines, parallel to each other and to the t. a. and t. p. lines; this latter shows a somewhat less sharp angle in the cell than that made by the t. a. line, is then somewhat irregular and parallel to outer margin to vein 2 where it bends slightly outward and is nearly perpendicular to inner margin for the balance of its course. Beyond the t. p. line is a narrow, parallel, pale band, edged by a black line and this is followed by the second ruddy-brown band which fills the sub-terminal area to the wavy white s. t. line, beyond which the terminal area is smoky, sprinkled with fine white scaling. A black terminal line, cut by pale dots at the veins. Fringes light smoky with pale basal hairline and dark checkering in the basal half. Secondaries smoky with well defined discal dot and a pale, curved postmedian band, along the inner side of which the smoky shading is intensified; terminal area heavily smoky with traces of a pale irregular s. t. line cutting through it. Two pale streaks along inner margin opposite discal spot. Terminal area and fringes as on primaries.

Beneath dull whitish, rather heavily sprinkled with smoky and with the maculation of the upper side, especially on secondaries, more or less reproduced in black and white. Expanse 17 mm.

Genitalia. (Fig. 7). Ventral plate of eighth segment composed of two thin closely approximate parallel chitinous rods, slightly bent inward at apex, and narrowly joined at base. Uncus bifid. Claspers rather narrow, rounded apically. Aedeagus very thin, slightly expanded at apex which is finely hirsute; armature consists of a single, long, paddle-shaped, chitinous rod, somewhat hollowed at base and gently expanding apically, the distal section being strigate.

Holotype—♂, Lone Pine, Calif., May 4, 1940 (E. C. Johnston); No. 5600 in the Canadian National Collection, Ottawa.

I take great pleasure in naming this beautiful species after the collector, from whom I have received much interesting material. *Johnstoni* is evidently closely allied to the European *pulchellata* Steph. and falls into the same group.

Eupithecia litoris n. sp.

Female. Antennae thin, faintly annulate, feebly ciliate. Palpi quite short, projecting only slightly beyond the flat front, deep gray. Head and thorax gray. Primaries deep gray, rather shiny, with faint maculation. The basal half of costa shows several obscure smoky blotches which probably represent the commencement of subbasal and antemedian cross-lines; there is also some dark spotting on cubitus and vein 1. A more distinct dark blotch on middle of costa gives rise to a faint smoky median line which crosses the cell just basad of the discal streak and is rather irregular in its course, forming a small inward angle on vein 2 and bending obliquely inward across the fold, ending on middle of inner margin in a slightly darker spot. A prominent, upright, black, discal streak, composed of slightly raised scales is present. T. p. line arises from a dark blotch on costa and bends sharply outward opposite the cell to vein 6, then continues parallel to outer margin, emphasized by a series of dark dots on the veins. There

is an obscure, rather large, dark blotch on costa, midway between t. p. line and apex of wing, and a double series of dark dots, paralleling t. p. line, in the subterminal space, the outer series slightly bordered by pale shades outwardly (s. t. line) and terminating in a somewhat more prominent spot below vein 2. Terminal area weakly suffused with smoky with a prominent black terminal line, broken, as usual, by pale dots on veins. Fringes concolorous, feebly checkered with smoky in basal half. Secondaries light smoky gray, deepening in color toward outer margin. There is some black spotting along inner margin with indications of dark postmedian and subterminal lines shown by dark dots on the veins. Discal dot small and obscure. Terminal area and fringes as on primaries. Beneath much as above in color with secondaries somewhat paler. Maculation of upper side faintly repeated on primaries; on secondaries a discal streak and strongly rounded postmedian line are more prominent. Expanse 20 mm.

Genitalia. (Fig. 5). Ostium membranous. Collar moderately wide. Ductus bursae wide and broadening distally, with the ductus seminalis arising from its apex on the right side as a narrow tube, curving caudad. Bursa globular, spined over almost its entire surface, with the exception of an area on the upper left side ventrally, extending across to the ductus seminalis. On the dorsal surface the spining extends all the way up the left side and is connected with a small patch of spining at the base of the ductus seminalis.

Holotype—♀, Ensenada, Baja Calif., Mar. 25 (Cockerell); No. 5601 in the Canadian National Collection, Ottawa.

Paratypes—2 ♀, Three Arch Beach, Calif., Feb. 8, Apr. 12, 1934 (Newman); 1 ♀, Gavilan, Calif., Mar. 19, 1934 (ex Coll. Sperry).

The paratypes are much worn and in consequence the color of primaries shows a more ochreous tinge than that of the very perfect specimen from Lower California; the genitalia, however, are similar. There is also a worn male, without abdomen, from Riverside, Calif., Apr. 3 (Coll. Sperry), before me, which probably belongs here. In this the antennae are quite strongly ciliate and the dark costal patches more evident.

***Eupithecia neomexicana* n. sp.**

A small dark species with narrow pointed primaries and obscure maculation.

Male antennae shortly ciliate. Palpi moderate, projecting somewhat beyond the flat front. Vestiture of front and vertex smooth gray, considerably suffused with black, and with black bands on anterior margin and in front of antennae. Thorax gray, suffused with black on anterior section. Abdomen smoky with black band across second segment. Primaries deep smoky, crossed by obscure dark t. a. and t. p. lines; these lines are rounded outwardly below costa and then run parallel to the outer margin and to each other, *i. e.*, inwardly oblique, to inner margin at $1/3$ and $2/3$ respectively. Discal streak slightly outwardly oblique, black, prominent. From a dark patch on costa between t. p. line and apex an obscure dark band runs parallel to outer margin and beyond it some dull palish spots close to outer margin indicate the obsolescent s. t. line. Terminal area dark with a black line along outer margin. Fringes deep smoky, slightly checkered and with a pale hair-line at base. Secondaries smoky, paler in costal half of wing, and with a fine, black, discal streak. Dark shading above inner margin, separated by paler areas, indicates basal, postmedian and subterminal lines; a pale dentate s. t. line is also fairly distinct, especially in lower half of wing. Terminal area and fringes as on primaries.

Beneath primaries scarcely paler than above with the maculation of upper side weakly reproduced. Secondaries steel-gray, with fairly evident dark discal streaks, subbasal and postmedian lines rather sharply angled opposite cell and

a crenulate subterminal line. Black marginal line very prominent. Expanse 16 mm.

Genitalia. Male. (Fig. 6a). Ventral plate of eighth segment composed of two fine, parallel, chitinized rods, joined at base and bent slightly outward at apex. Uncus bifid. Clasper broad, sharply angled beyond middle and with rounded apex. Aedeagus broad; besides the basal piece of chitin and a long, thin, partially hollowed out piece, the armature consists of four strong pointed rods or spines of which one is twice the length of the others, another slightly curved at base and a third strongly bent backward at base, with gently curved apex.

Female. (Fig. 6). Ostium membranous. The chitinized collar is very broad and is not noticeably separated from the broad chitinous ductus; its caudal margin is strongly convex. The ductus bursae is long, broad, trough-like and chitinized for its entire length, with a raised edge of chitin on the left side; the ductus seminalis arises from its apex on the right side, with a rather broad opening. Bursa moderately small, globular, membranous; at its proximal end bands of strong spines extend across both its surfaces to the base of the ductus seminalis, the spines decreasing in size from left to right; above the fundus is an isolated patch of large spines.

Holotype—♂, Frijoles Can., N. Mex., Sept. 10, 1941 (G. & J. Sperry); No. 5602 in the Canadian National Collection, Ottawa.

Allotype—♀, same data, Sept. 8.

Paratypes—2 ♀, same data, Sept. 8, 10; 1 ♀, Chiricahua Mts., near Douglas, Ariz., Aug. 29, 1908.

None of the specimens are in particularly good condition and it is probable that better preserved material will show clearer maculation. The genitalia in both sexes are sufficiently distinct to render the species easily recognizable.

THE RABBIT TICK, *HAEMAPHYSALIS LEPORIS-PALUSTRIS* PACK., AS AN ECTOPARASITE OF MAN.

It has always been presumed that the rabbit tick would not feed on man, and a careful search of the literature fails to show any record of it doing so. Therefore the following incident that occurred during February, 1945, is of interest.

Mr. S., age about 45, a section worker on the Canadian National Railroad at Ferintosh (near Camrose), Alta., had handled about 13 rabbits during the winter. These rabbits had been killed by trains. He had collected the carcasses and taken them home where he skinned them and fed them to his chickens. On February 9 he found a half-engorged tick attached to the inside of his left forearm just below the elbow. There were two definite lesions, one where the tick was attached and one just below it. Mr. S. removed the tick alive and kept it in his possession; he then visited his family physician at Camrose and the doctor sent him to Edmonton. I examined and identified the tick as being *Haemaphysalis leporis-palustris* Packard.

As tularemia infection is well-established in the Camrose area, the rabbit tick was ground-up and injected into a guinea pig. No indication of *P. tularensis* infection was found.

J. H. Brown,
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